

Space Weather Technical Forecast

Issued on Friday, 03 June 2022 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Active Electron Fluence. Chance of G1/Minor Storm intervals with a slight chance of G2/Moderate Storm either later Day 3 or early Day 4 (05-06 June) from possible CME arrival(s).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with a C1 flare observed from a prominence eruption on the east limb. There are four sunspot regions on the visible disc, with the most prominent AR3026 (Cai/Beta) in the northwest quadrant. AR3027 (Dso/Beta) in the southern central disc is also of interest due to its reverse polarity for a SC25 southern hemisphere spot. The other two regions are small unipolar spots. A potentially Earth-directed CME was observed from a filament eruption in the southwest disc at 02/0510UTC, with this possibly giving a glancing blow either later on 05 June or on 06 June.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been at largely background levels through this period. Wind speed has declined slightly from around 400 km/s to near 360 km/s. Density has been near to below average. The interplanetary magnetic field strength, Bt, has been weak below 5nT, with the north-south component, Bz, varying weakly between +/-4nT, but predominately in the negative direction. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels. The high energy electron flux (greater than 2 MeV) has been at High levels throughout, reaching 9250 pfu at 02/1550 UTC. Electron fluence has been above the Active threshold on a slowly rising trend, reaching 3.95e8 integrated pfu at 03/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Very Low, with a chance of further C-class flares and a slight chance of M-class flares, primarily from AR3026.

Solar Wind / Geomagnetic Activity: Two filament lift-offs have been observed, the first around 01/0100 UTC, and the second around 02/0530 UTC. They have both given CMEs with the potential for a glancing blow at Earth. These two CMEs may combine for an arrival either later on Day 3 (05 June) or during Day 4 (06 June). Both CME assessments carry low confidence, however.

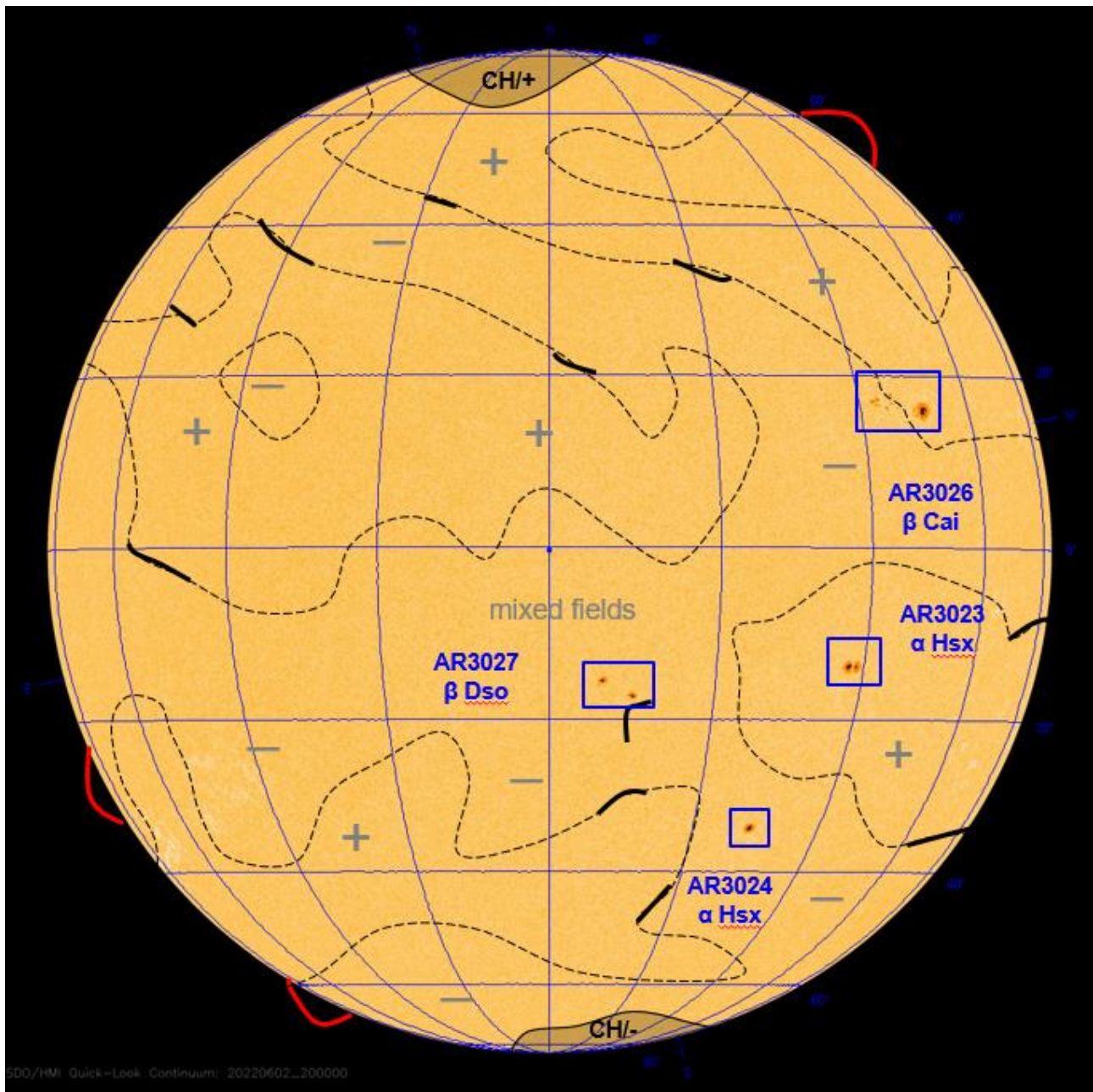
Aside from the CMEs, background wind speeds are expected to persist through the period. Geomagnetic activity is forecast to be predominately Quiet through to Day 3, but increasing to Unsettled to Active with a chance of G1/Minor Storm, and a slight chance of a G2/Moderate Storm, if we see the CME(s) either later Day 3 or early Day 4.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period. High energy electron flux (greater than 2MeV) is likely to continue at mainly High levels, with peak values only gradually easing later in the period, perhaps dropping out on Days 3 or 4 (05 or 06 June) due to any CME arrival. Electron fluence levels are expected to be Active throughout (1e8 integrated pfu), likely declining

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

by the end of the period, but again perhaps dropping out if we see a CME arrival.

Figure 1. Solar Analysis Valid 02/2000 UTC.



Key: Filament ___, Prominence ___, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A filament lift-off was observed from the centre disc around 01/0100 UTC, with an associated coronal dimming. A weak CME was produced, which has been assessed as a slow CME, giving a slight chance of a glancing blow. A further filament eruption has since been observed leaving the southwest disc around 02/0530 UTC. This has also given a CME with the potential for a glancing blow. These two CMEs may combine for an arrival either later on Day 3 (05 June) or during Day 4 (06 June). Both CME assessments carry low confidence, however.

Aside from the CMEs, background wind speeds are expected to persist through the period with no notable coronal hole fast wind enhancements expected.

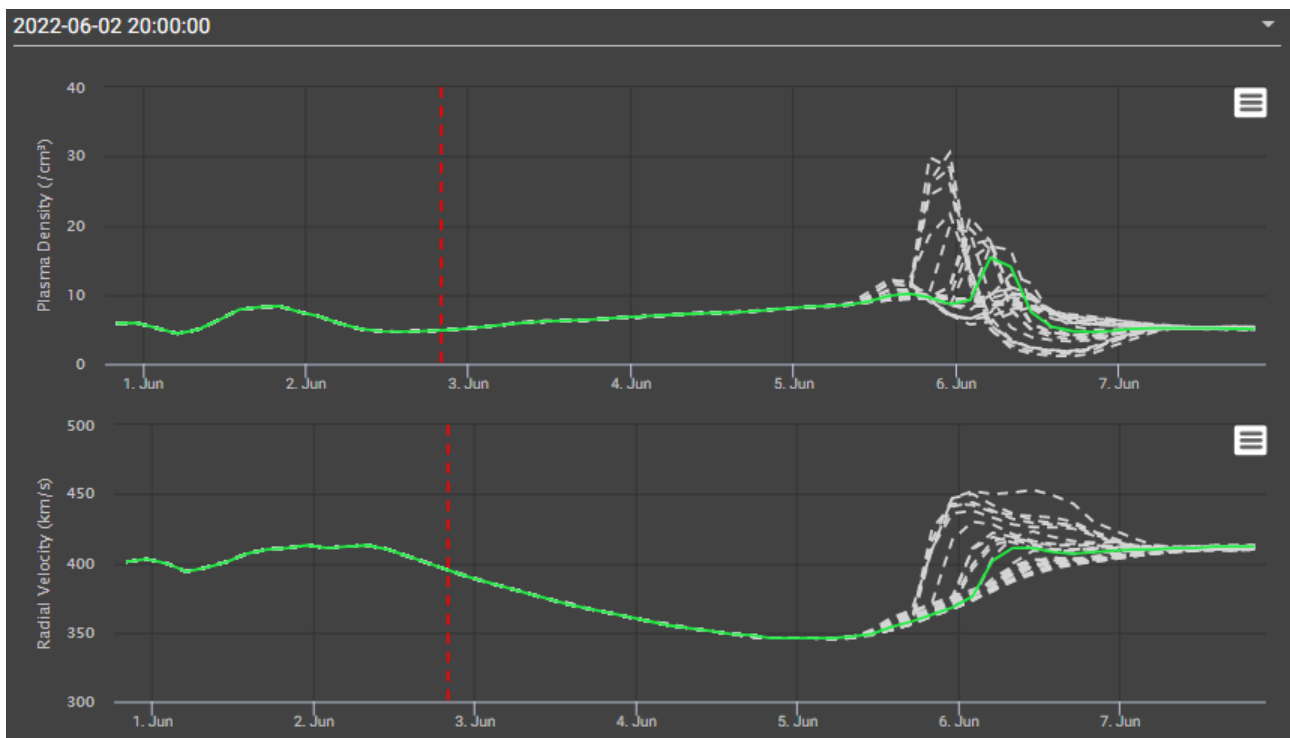
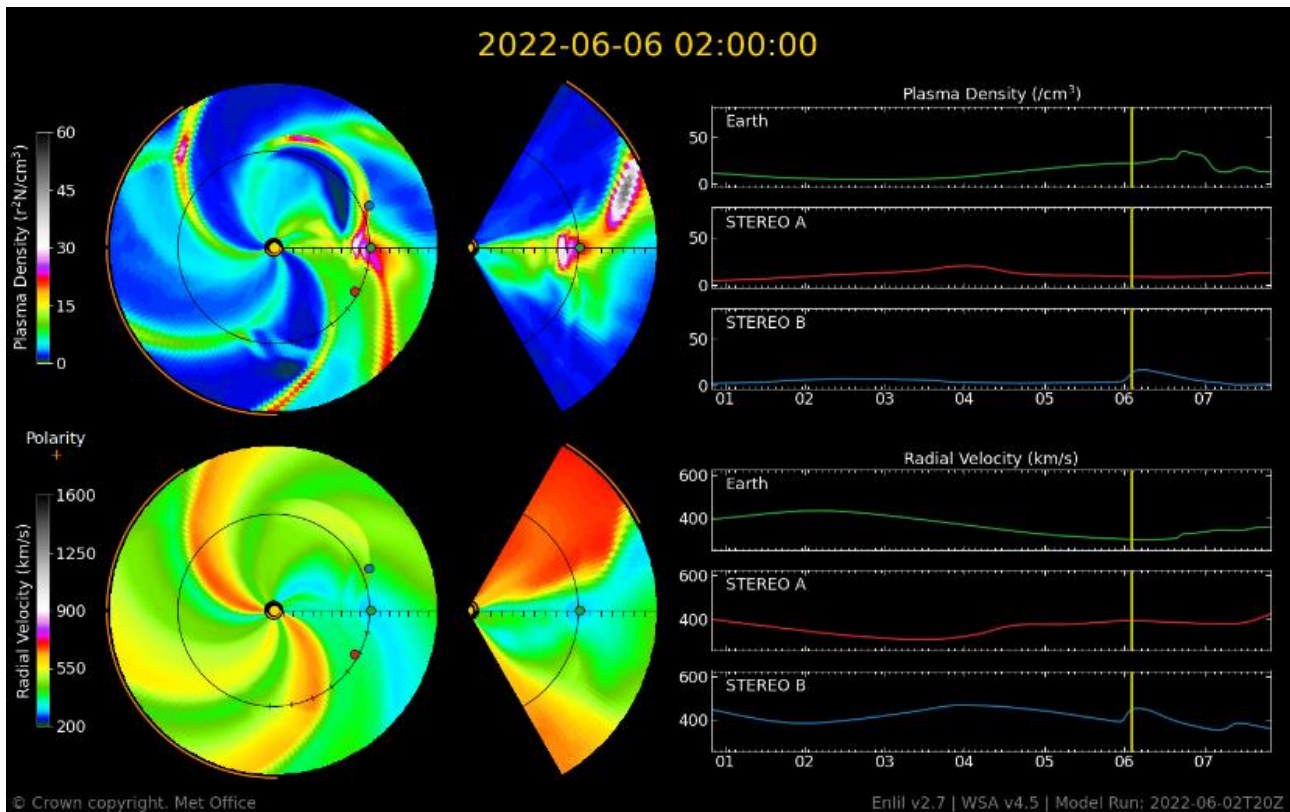
Geomagnetic activity is forecast to be predominately Quiet through to Day 3, but increasing to Unsettled to Active with a chance of G1/Minor Storm, and a slight chance of a G2/Moderate Storm, if we see the CME(s) either later Day 3 or early Day 4.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	30	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1300	Partial	Filament	4N 10W	252	05/1800 +/- 12 hours	Limited shock. Weak and low confidence.
02/1315	Partial	Filament	6S 45W	525	06/0000 +/- 12 hours	Glancing blow possible. Low confidence.

Figure 2: Enlil and ensemble, showing a possible CME arrival either late on 05 June or on 06 June.



Radio Blackouts - X-Ray Flares:

Solar activity is currently Low with one C1-flare occurring in the last 24 hours. Despite four regions on the Earth-facing disc, this flare occurred from a prominence eruption on the limb. As such there is the potential for a sunspot region to be located at the source of the flare which may rotate onto the disc during Day 1 (03 June).

The main region of interest on the Earth-facing disc is AR3026 (Cai/Beta), however this region has now largely stabilised, albeit with changes in the shape of the leading spot. AR3027 (Dso/Beta) is another small region near south centre disc, however it is of note due to its reverse magnetic polarity for a southern hemisphere spot according to Hale's Law. The other two sunspot groups are both small and simple unipolar regions.

Activity is expected to remain Low to Very Low with a chance of further C-flares, and a slight chance of rising to Moderate due to isolated M-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is expected to remain at this level, with AR3026 having simplified in the last 24 hours.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event ($\geq 2\text{MeV}$):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 has been at High (greater than 1000pfu) levels through the last 24 hours due to the recent fast wind enhancement. With no further notable disturbances forecast for the solar wind environment at Earth through to Day 3 (05 June), these mainly High levels are expected to persist, although peak values are likely to gradually decline. However, either later on Day 3 or early on Day 4 (06 June) the potential for CME arrival(s) will bring the chance of flux levels dropping out.

The associated 24 hour electron fluence is currently Active (greater than $1\text{e}8$ integrated pfu) and is likely to persist at this level through the period, but any CME arrival could cause a dropout either later on Day 3 or early on Day 4. REFM is showing a fairly rapid decline in fluence levels, which is thought to be too fast as electron levels usually take a period of time to decline in the absence of CME influence.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	100	90	70	60
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	2	2	1	1

Figure 3: REFM is suggesting a rapid decline in electron fluence values. This is likely to be too fast, with fluence levels likely only slowly declining in the absence of CME influence.

